STATEMENT OF BASIS

for

Proposed Soil, Soil Gas and Groundwater Cleanup

Prairie Ronde Realty
(Former National Copper Products)
Dowagiac, MI

EPA I.D. No. MID 005 068 507

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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April 2015

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INTRODUCTION

This *Statement of Basis* (SB) is for the Prairie Ronde Realty Company (PRR) site, or Former National Copper Products (NCP) facility (the "Facility" or "site") located in Dowagiac, Michigan. This SB presents the proposed corrective measures to address contamination at the Facility pursuant to the U.S. Environmental Protection Agency's (EPA) June 2, 2006 Administrative Order on Consent (AOC) with Prairie Ronde Realty and National Copper Products. EPA will select a final remedy only after the public comment period has ended and the information submitted during this time has been reviewed and considered. EPA is issuing this SB as part of its public participation responsibilities under the Resource Conservation and Recovery Act (RCRA).

This document summarizes information that can be found in greater detail in the *Corrective Measures Proposal* (CMP) and other documents contained in the administrative record for this Facility (*see* Attachment 1). EPA encourages the public to review these documents in order to gain a more comprehensive understanding of the Facility and activities that have been conducted there under RCRA, 42 U.S.C. §6901 et seq. The administrative record can be found at the local repository located within the Dowagiac District Library[1] and at EPA's Chicago office[2] and at the following website: *http://www.epa.gov/region5/cleanup/rcra/NationalCopper/index.htm.*

EPA may modify the proposed remedy or select another remedy based on new information or public comments. Therefore, the public is encouraged to review and comment on all corrective measure alternatives. The public can be involved in the remedy selection process by reviewing the documents contained in the administrative record and submitting comments to the EPA during the public comment period.

PROPOSED CORRECTIVE MEASURES

EPA is proposing the following corrective measures, in addition to the interim measures that have already been implemented at the site, to address contamination at the Facility. For a full

[1] Dowagiac District Library, 211 Commercial St., Dowagiac, MI
[2] EPA Region 5, 77 W. Jackson Blvd., Chicago, IL

explanation of the proposed remedies, see the *Summary of Alternatives Section* and Attachment 2.

1) *Groundwater Pump and Treat*: The existing groundwater pump and treat system that has been in operation since 1985 will remain in operation for the purpose of maintaining an inward groundwater gradient and treatment of contamination until such time when intermediate remedial groundwater goals are achieved and sustained. The inward gradient will contain the existing chlorinated solvents groundwater plume and prevent further migration while continued extraction and treatment of the chlorinated solvents occur. The intermediate groundwater remedial goal is the Michigan Part 201[3] Groundwater/Surface Water Interface (GSI) standard developed to prevent groundwater contamination from creating unacceptable impacts when it migrates to surface waters. Long-term groundwater remedial goals are the EPA Maximum Contaminant Levels (MCLs)[4]. For additional details regarding the groundwater contamination and screening levels, see the *Investigation Results Section*.

2) *Enhanced Reductive Dechlorination (ERD)*: The on-going pilot study involving anaerobic biodegradation of contamination in the groundwater will be expanded as a full-scale final remedy. The successful pilot study has included an ERD mixture of lactates, fatty acids, a phosphate buffer, and zero-valent iron that can successfully treat and reduce the concentrations of trichloroethene (TCE) and its degradation by-products contained in the facility's groundwater through a combination of dechlorination and bioremediation. The ERD is designed to help achieve long-term groundwater remedial goals.

3) *Bioaugmentation (as needed)*: As a component of the ERD technology, the native bacterial colonies responsible for the reduction of contamination, called Dehalococcoides (DHC), will be monitored. These are the naturally-occurring organisms responsible for the bioremediation of the chlorinated solvents. Their presence is necessary to complete the reactions that reduce the contaminants. When necessary, bioaugmentation (the addition of native bacterial cultures required to increase the rate of degradation of contamination) will be conducted as part of the ERD to enhance or repopulate the bacteria.

4) *On-Site & Off-Site Sub-slab Depressurization Systems (SSDS)*: The current SSDS installed under the commercial building located on-site will continue to operate until soil gas remedial goals are achieved to protect workers from potential vapor intrusion and demonstrate sufficient mass reduction protective of human health and cross-media contamination. The long-term goal of the SSDS is to remediate the vadose zone soils beneath the building until they no longer serve as an unacceptable source to either groundwater or soil gas. Until such time, the SSDS will continue to serve as an

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[3] http://www7.dleg.state.mi.us/orr/AdminCode.aspx?AdminCode=Department&Dpt=EQ&Level_1=Remediation+and+Redevelopment+Division

[4] http://water.epa.gov/drink/contaminants/

effective vapor barrier to protect indoor air. The system will be subject to optimization measures, including potential expansions, as it is evaluated through time. The SSDS currently in place at one downgradient residence will continue to operate. Although the soil gas investigations have not demonstrated indoor air impacts in the off-site residential properties, EPA is proposing SSDSs be installed at 10 residential properties as a component of a protective final remedy. The soil gas within the residential area continues to demonstrate high concentrations of TCE. This proposed remedy protects residents from the contaminated soil gas should the vapor intrusion pathway become complete in the future.

5) *Monitored Natural Attenuation (MNA)*: Groundwater MNA will augment the engineered remedies described above in order to achieve the long-term remedial groundwater goals, MCLs. The MNA program will evaluate whether natural processes will lead to sufficient further reductions of chlorinated solvents after the highest levels of contamination have been removed through extraction and/or treatment. MNA will consist of specific monitoring parameters conducted on a regular basis, as defined in the Corrective Action Monitoring Plan (CAMP). The CAMP is a multi-media monitoring program with various points of compliance and potential receptors of interest. It will be implemented to monitor the progress of remediation and confirm the attainment of remedial goals. Parameters may include, but are not limited to: constituent concentrations, geochemical indicators, microbial communities, and microbial functional genes. These types of parameters will demonstrate the rate and success of MNA. The CAMP will be submitted as part of the remedy implementation work plan.

6) *Institutional Controls (ICs)*: The existing deed restriction on the PRR property will be maintained and upgraded as necessary to ensure the facility's land use remains commercial or industrial in the future and groundwater is prohibited for potable use (*see* Attachment 3). Off-site properties within the City of Dowagiac are currently protected by an Ordinance that prohibits the use of groundwater wells for new construction. A new or revised Ordinance will be pursued that would restrict groundwater use within a restricted zone near the PRR property consistent with MDEQ guidance. EPA will require a re-certification process at regular intervals to ensure ICs are being appropriately applied and maintained.

7) *Financial Assurance*: Prairie Ronde Realty must demonstrate a financial ability to complete the proposed remedy and long-term monitoring by securing an appropriate financial instrument.

8) *Five-year Remedy Reviews*: The Agency proposes five-year remedy reviews as a means to update the conceptual site model and determine whether or not remedial actions are obtaining the stated remedial goals. These reviews provide information and data for necessary system adjustments to account for remedy efficacy and efficiency of the corrective measures.

FACILITY BACKGROUND

Location and History

The Prairie Ronde Realty site is a former copper tubing facility located in Dowagiac, Michigan. Dowagiac is located in Cass County, in the southwestern portion of the State of Michigan.

The original facility owner, Sundstrand Heat Transfer, discovered groundwater contamination at the Facility in 1983 (*see* Figure 13). Subsequently, Sundstrand entered into a Consent Judgment with the MDEQ to abate the contamination. Under that Consent Judgment, the groundwater pump and treat system was installed in 1985 and operated in order to control the migration of contaminated groundwater. Various environmental investigations and remedial measures were conducted during the 1980s and 1990s with MDEQ oversight.

Prairie Ronde Realty Company acquired the property at 415 East Prairie Ronde Street in Dowagiac, Michigan in 1995 (*see* Figure 1). National Copper Products formerly operated the facility as a copper tube mill and, at that time, PRR continued to lease the property to NCP. In 2004, MDEQ requested the EPA assume the regulatory lead for the site. The facility continued to manufacture copper tubing up through 2008, until NCP filed bankruptcy in 2009. PRR currently leases the building to various commercial entities but does not produce any industrial products at the site.

PRR is subject to corrective action because they are the owner of a facility that operated under interim status subject to Section 3005(e) of RCRA. As such, the facility managed certain wastes or constituents that are hazardous pursuant to Sections 1004(5) and 3001 of RCRA and 40 C.F.R Part 261. Whenever EPA determines that there is or has been a release of hazardous waste into the environment from a facility authorized to operate under section 3005(e) of this subtitle, the EPA may issue an order requiring corrective action or such other response measure as deemed necessary to protect human health or the environment. EPA issued an Administrative Order on Consent on June 2, 2006. Pursuant to that Order, the proposed final remedies presented in this document will protect human health and the environment.

SITE SPECIFIC CHARACTERISTICS & SETTING

Hydrogeological Setting

The geology within the area of the Facility consists of glacial outwash deposits. There are two aquifers within the area of investigation separated by a semi-continuous, variable aquitard (*see* Figure 4). The upper aquifer has an approximate 25 to 30-foot saturated thickness with the water table generally found at 20 to 25-feet below ground surface (bgs). The composition of the upper aquifer is fine to medium sand with a gradation downward of fine to medium sandy gravel. Beneath this aquifer is the semi-continuous aquitard of inter-bedded clay, fine silty sand, clayey silt and clayey sand. It appears variable in thickness across the area but is persistently found at approximately 50-60 feet bgs. The lower aquifer is found beneath this clayey aquitard with a composition of inter-bedded sand and gravel.

The groundwater flow at the site is in the northwesterly direction, which follows the topography of the site as the land dips down towards Pine Lake (*see* Figure 5**)**. Local areas of groundwater-to-surface water interface exist intermittently at "seeps" found in topographical lows. Other areas receiving surface water include two man-made drains, the Pine Lake Drain on the east and the "Unnamed Drain" on the west side of the facility. Figure 5 shows the groundwater surface and flow direction in addition to these surface water bodies. The GSI Monitoring Wells, shown on Figure 5, represent the locations where regular groundwater monitoring takes place to evaluate the existing pump and treat system's protectiveness of the surface water. (The pump and treat system was installed as an interim measure in 1985.) The figure shows the locations of these pump and treat wells, called Purge Wells, as well as the influence they have on nearby groundwater flow.

Ecological Setting

Currently, there is no suitable ecological habitat within the Former NCP facility's site boundary. The facility is occupied by a building, parking lots, and roads. The entire area is fenced and maintained as an industrial property. However, suitable ecological habitat exists north and west of the Facility and includes Pine Lake and its associated wetlands.

The area north of the site is mostly open space and natural areas. This area is associated with Pine Lake, Pine Lake Drain and the unnamed drain west of the Facility. Potentially sensitive environments in the area include surface waters, wetlands, and protected species' habitat (*see* Figure 6**)**. The evaluation of potential impacts to these areas from on-site activities has been performed in the Ecological Risk Assessment.

Pine Lake Drain, located east of the Facility, is a man-made drain that originates in municipal and industrial areas south of the site and flows past the facility into Pine Lake. City storm sewers and Rudy Road Drain discharge into Pine Lake Drain.

The Unnamed Drain, located west of the Facility, originates as a storm sewer upgradient of the site. It flows to the northwest through a disturbed habitat that supports wild black cherry and honeysuckle, among other species. The Unnamed Drain continues flowing to the northwest through several wetlands. It is joined by a drain flowing from Pine Lake, continues flowing generally to the northwest under highway M-51, and eventually to the Dowagiac River approximately 2.5 miles to the northwest.

There are several other small seepage areas that emerge towards the west and north, shown on Figure 5. These seeps are often dry. Water, when present, is very shallow (one or two inches) and the sediments are muck.

To the west along the unnamed drain, and to the north, there are wetlands ("fens"). A variety of wetland types have been identified near the site, and include scrub shrub, emergent marshes, and forested and fen wetland habitats. The scrub shrub wetlands are dominated by red-osier dogwood

(Cornus stolonifera), panicled dogwood (Cornus racemosa), large-leaved avens (Geum macrophyllum), elderberry (Sambucus Canadensis), speckled alder (Alnus rugosa), spice bush (Lindera benzoin) and poison sumac (Toxicodendron vernix), and in certain locations the emergent marshes are dominated by Typha lattifolia and Lythrum salicaria. The forested wetlands are dominated by silver maple (Acer saccharinum), with wild black cherry (Prunus serotina) and honeysuckle (Lonicera sp.) on the edges.

The Southwest Michigan Land Conservancy[5] inspected the general area surrounding the site around 2003 to identify specific habitat for protected species. The following protected species were identified in the area, but not specifically on site: Rosinweed, Edible Valerian, and Mitchell's Satyr butterfly. These potentially relevant receptor groups were included in the ecological risk evaluation. Figure 6 shows the various habitat areas qualified by the Land Conservancy by assigning the areas number designations. The designations (high, medium, and low quality) are based on disturbance levels relative to an undisturbed prairie fen habitat. High quality areas have the least disturbance and low quality areas are more disturbed; disturbance is related primarily to invasive species and artificial drainage, not Facility-related contamination.

The Mitchell's Satyr butterfly or its suitable habitat was identified in two "conservation zones" in the wetland areas northeast of the Site (*see* Figure 7), but have not been identified on the Site. These conservation zones, primary and secondary, have not been impacted by the volatile organic compound (VOC) releases at the Site. The distinction between the two zones is confirmed sightings of the butterfly, which has only occurred in the primary conservation zones. The secondary conservation zone is considered suitable habitat for the butterfly but its presence in those areas has not actually been confirmed.

<u>Interim Remedial Measures</u>

Interim measures have been implemented at the Facility to mitigate risks and reduce further migration of contamination. These actions have been consistent with the long-term remedial strategy at the site and are consistent with the proposed final remedies presented in this document. Interim measures have included: contaminated soil excavation and off-site disposal, a groundwater pump and treat system, soil vapor extraction and air sparging, sub-slab depressurization systems, and enhanced reductive de-chlorination pilot studies. These interim measures have collectively removed an estimated 6,642 cubic yards of metals-contaminated soil and 225,890 pounds of TCE from groundwater and soil. Figure 8, attached, illustrates the pounds of TCE removed per day through various technologies from 1986 through 2012. Details of each interim measure are presented below.

Soil Excavation and Off-Site Disposal

In the 1980's, soil excavation was performed under an MDEQ-approved work plan at the Former Oil and Solvent Storage Room (OSSR) and the Old Borrow Pit (OBP), and later at the Furnace Brick disposal area. Figure 2 shows the approximate locations and dimensions of the areas of soil excavation.

[5] http://www.swmlc.org/

The 1984 OSSR soil removal included 508 cubic yards of contaminated soil from an area measuring 2,670 square feet. Eight underground storage tanks (USTs), which historically contained solvents, were also removed at that time. Figure 9 shows the initial conditions in this area, including: the Oil and Solvent Storage Room relative to the entire building, the former location of the historic underground solvent storage tanks, and the soil and groundwater TCE concentrations at that time. The contaminated soils and USTs were disposed of off-site as hazardous waste. The area of excavation was backfilled with clean soil and then covered with a concrete slab. Figure 10 shows the approximate limits of the excavation. The excavation took place beneath the existing building and extended down to a depth of approximately 16-18 feet below the slab. Due to concerns about the integrity of the building and worker safety, the excavation was unable to proceed any deeper. PRR was unable to locate records regarding confirmation sampling; however, potential current risks were evaluated with the data available from the soils left in place (excluding the clean fill); EPA's risk assessments concluded this area no longer presents an unacceptable risk from soil with the operation of the SSDS.

The OBP was excavated in 1984 down to the surface of groundwater and laterally until confirmation samples demonstrated contamination from metals was below MDEQ's direct contact criteria. An estimated 4,826 cubic yards of soil was excavated and disposed of off-site. Additional investigation of this area in the 1990's demonstrated that copper concentrations in the soils remained elevated. It was determined that the source of the copper was historic disposal of furnace bricks adjacent to the OBP area; therefore, additional excavation took place in 1997.

The excavation of the former furnace brick disposal area in 1997 removed approximately 1,308 cubic yards of brick waste. Confirmation samples showed that copper concentrations in the remaining soil were below residential direct contact criterion. The area was graded with clean soil, covered with topsoil, and seeded. The groundwater within this area, as well as down gradient, has not indicated any metals contamination. The risk assessments concluded this area no longer presents an unacceptable risk from soil.

The contaminated groundwater under all of these areas of soil excavation continues to be impacted by historic TCE, which will be addressed through the proposed final remedies. However, the additional interim measures discussed below have substantially reduced TCE concentrations in both soils and groundwater both on and off-site.

Groundwater Pump and Treat

In 1985, a groundwater remediation system with 12 purge wells was installed and put into operation. The original purge well system was designed to capture contaminated groundwater and control the further migration of contaminants. The system has been modified and refined through the years as the contaminant conditions changed; seven original purge wells have been closed, and five new wells have been installed.

The system is still operating today and is a component of the proposed final corrective measures presented in this document. The wells are located near the source areas on-site and along the forward edge of the impacted groundwater to protect surface water bodies and prevent further migration. The system has been periodically evaluated and occasionally adjusted in accordance with monitoring data or for necessary infrastructure updates.

The recovered groundwater is pumped to a treatment facility where it is air-stripped. The air stripper removes contaminants from the water. The remediated water is then discharged to the Rudy Road Drain, in accordance with a State permit. The current system has the capacity to pump over 1,000,000 gallons of water per day. It has effectively protected the surrounding surface waters by maintaining an inward hydraulic gradient towards the Facility. Approximately 124,565 pounds of TCE has been removed from the groundwater by this system. Figure 11 shows the locations of the current purge wells. The success of the system at reducing the footprint of contamination in groundwater can be seen graphically depicted in Figures 13-15.

Soil Vapor Extraction (SVE) and Air Sparging (AS)

In 1994, an SVE system was installed beneath the building on-site to remove residual VOCs, such as TCE, from the soil, thereby preventing them from migrating into the groundwater. Originally, nine SVE wells were installed based on the results of a soil vapor study. In 1998, the system was expanded by adding 13 additional SVE wells and an air sparge (AS) system. The AS system beneath the building included 15 air injection wells and served to drive VOCs off the groundwater and capillary fringe soils into the soil gas. The contamination was then captured within the soil gas phase by the SVE system. The soil gas collected by the system was directed through carbon adsorption beds where the VOCs were captured. The carbon beds were steam-stripped and the recovered solvent was drummed for off-site disposal. Approximately 101,500 pounds of TCE was removed from the soil and groundwater on-site by the combination of the SVE and AS systems.

An additional AS system was installed off-site (northwest of the Facility) at the leading edge of the groundwater contamination in 1998 and was operated until 2008 (*see* Figure 2). This system consisted of 10-air injection wells installed at the northwestern part of the groundwater contamination. This system also operated to reduce VOC concentrations in the groundwater within the upper 15-20 feet of the shallow aquifer. This AS system was located in a lowland area where groundwater eventually discharges to surface water. The purpose of the enhanced remediation in this area was to accelerate achievement of the MDEQ Part 201 GSI criteria. The groundwater concentrations of TCE within this area were subsequently reduced. For example, the TCE concentration decreased from 1400 ppb to 8.5 ppb in a particular well, and the TCE concentration at the furthest down-gradient location decreased from 351 ppb in 1998 to 1.1 ppb in 2013.

Both SVE/AS systems were shut down in 2008 after an analysis of their continued effectiveness: the soil gas data at that time showed TCE concentrations in the soil had declined. The extraction rate had dropped from 55 pounds of TCE per day in 1995 to less than 0.5 pounds per day in 2007, making it no longer efficient to operate the system (*see* Figure 12**)**.

Recent monitoring has shown VOC concentrations, especially TCE, have rebounded within the on-site soil gas. This phenomenon is not unexpected with chlorinated solvents. As subsurface areas are remediated, those geologic layers with larger-grained materials (higher hydraulic conductivity) tend to remediate fastest. Once the remedial technology is shut off, and the system allowed time to equilibrate, the finer-grained materials, which were "holding" contamination, begin to "back diffuse" into the previously remediated zones. This behavior characterizes the rebound in concentrations detected. Consequently, the proposed final remedies described below will address the on-site soil gas and the remaining historical source areas still available to partition into soil gas and groundwater.

Sub-Slab Depressurization Systems (SSDS)

A SSDS is a vapor mitigation system that addresses the risk associated with soil vapor intrusion to indoor air. A SSDS uses a vapor collection system to capture vapors emanating from contaminated subsurface environmental media (groundwater and/or soil) before they can enter a building. The systems operate in the same manner as radon mitigation systems by creating a vacuum beneath the structure, pulling the contaminated vapors out through pipes, and safely discharging those vapors outside the home.

A SSDS was installed at a residential property west of the facility in 2009. Based upon sub-slab VOC concentrations and an indoor air sample slightly above the TCE screening criteria (*see* Table 1), PRR installed the SSDS. Subsequent confirmatory sampling has demonstrated that the SSDS was an effective interim measure for eliminating that exposure pathway and it will be incorporated into the proposed final remedy presented in this document. Additional residential SSDSs are proposed as part of the final remedy.

An on-site SSDS was installed at the industrial building in 2012 after finding a complete vapor intrusion pathway. Both the sub-slab soil gas and indoor air demonstrated unacceptable concentrations of TCE. The SSDS has been effective at reducing the indoor air concentrations by maintaining a vacuum beneath the building. That data can be seen in Tables 3 and 4 provided in the following section. The on-site system is an interim corrective measure and a component of the proposed final remedy presented in this document.

INVESTIGATION RESULTS

Sampling data obtained during the facility investigations were first compared to screening criteria to determine if contaminants of concern were present at concentrations necessitating evaluation. Those contaminants detected at or above the applicable screening criteria were then evaluated in two ways: a human health risk assessment, used to help identify where risks to people might be unacceptable, and an ecological risk assessment, used to help identify where risks to wildlife or other ecological receptors might be unacceptable. Where risks are identified as potentially unacceptable to either current or potential future receptors, action is required to mitigate or eliminate that risk.

The human health risk assessment used the cleanup criteria for soil and groundwater developed by the MDEQ pursuant to Part 201 (soil and groundwater) and Part 31 (surface water) of Public Act 451 of 1994 (as amended) as screening criteria. These criteria incorporate toxicity assessments developed by the EPA in the Integrated Risk Information System and by the MDEQ. The human health risk evaluation was based on an excess lifetime cancer risk of 1 in

100,000, or $1x10^5$, and a hazard quotient of 1 for non-carcinogenic compounds, as set forth in the regulations[6]. The Part 201 criteria include available Maximum Contaminant Levels (MCLs) from the Federal Safe Drinking Water Act.

Risks associated with inhalation of residential and industrial indoor air were evaluated after the human health risk assessment was completed. The indoor air risks were screened using the EPA's Regional Screening Levels (RSLs). The RSLs also use EPA's toxicity assessments from IRIS, an excess lifetime cancer risk of 1×10^{-5} for carcinogens, and a hazard quotient of 1 for non-carcinogenic chemicals.

The ecological risk assessment used Soils Screening Levels (SSLs) established by EPA. EPA Region 5 Ecological Screening Levels (ESLs) were used if SSLs were not available. The ecological screening levels for surface water are the lower of the State of Michigan's Part 31 Water Quality Values or EPA Region 5's ESLs. The Water Quality Values are developed by the State under authority of the Federal Clean Water Act and Part 31 of Michigan Public Act 451 of 1994, as amended. The State develops water quality values for protection of aquatic life (chronic toxicity), wildlife and human health. The values for protection of wildlife and aquatic life were used as ecological screening levels for the ecological risk assessments.

The following sections summarize the investigation data, the human health risk assessment approach and conclusions, and the ecological risk assessment approach and conclusions.

Subsurface Conditions

The subsurface conditions and extent of contaminant impacts at the Facility have been comprehensively investigated by several entities since 1984. The site's hydrogeologic conditions and the nature and extent of contaminant impact are well documented. Glacial outwash deposits underlie the facility; in general, an upper layer of medium to fine sand grades to sandy gravel. This upper layer is typically 50 to 60 feet thick within the PRR property, and groundwater in this layer occurs under water table conditions at depths of about 20 to 25 feet. The unsaturated soil under the plant is typically fine, silty-sand.

Volatile organic compounds (VOCs) impacted the soil and groundwater beneath the facility, primarily TCE, prior to PRR acquiring the property in approximately 1995. The contamination was discovered in 1983.

Ongoing monitoring and supplemental studies have shown the various interim measures, described above, have reduced the VOC impacts to the site's soil and groundwater. Figures 13-15, for example, show the reduction of TCE in groundwater through time when screened against the GLI and MCL criteria. Also, Figure 8 shows the reduction through time of TCE captured and either destroyed or properly disposed of by the various corrective actions. However, several areas of relatively higher VOC concentrations remain, primarily in the original source areas at the plant. The following sections provide additional information regarding the investigation results.

[6] http://www.epa.gov/epawaste/hazard/correctiveaction/resources/guidance/anpr.htm

Soil Gas and Indoor Air

Chlorinated solvents such as TCE are volatile compounds that, under certain circumstances, can volatize (evaporate) out of the groundwater, or saturated soil, into the pore spaces of the soil. Once the compound leaves the liquid phase and is in the vapor phase it can move through the soil and migrate toward the ground surface. When there is a building located above that area of "volatilization", the compound can potentially enter the building through small foundation cracks or utility pathways. Indoor air within the building can be impacted by this volatilization; therefore, this particular pathway was included during both the on-site and off-site investigations. This type of investigation is referred to as a "vapor intrusion" investigation.

On-site and off-site soil gas investigations have been conducted through the years to evaluate the volatilization of contamination from the groundwater and soil into the soil gas. Both evaluations included sampling indoor air and sub-slab soil gas vapor (the air trapped within the soil directly beneath the building foundation). The investigations have also included sampling the soil gas within 'right-of-way' areas off-site. Although sub-slab data is the best kind of data to determine potential indoor air impacts, the area-wide soil gas samples also provide a picture of where the overall soil gas plume is located. The data from the soil gas plume can be found in the Vapor Intrusion Data tables below.

In 2009, PRR sampled sub-slab and indoor air at twenty residences to directly measure VOC concentrations in the indoor air that may be coming from the soil gas. Only one residence had an indoor air TCE concentration of 2.3 ug/m^3 above EPA's screening level of 2.1 µg/m^3. These findings were confirmed in a second sampling event. As a result of the findings, an SSDS was installed at that residence in August 2009. After the installation, operation, and additional ventilation, confirmatory samples indicated the exposure pathway at this residence was no longer complete and TCE was not detected above the screening level within indoor air.

As a means to evaluate whether the off-site soil gas conditions were improving, additional off-site soil gas samples were collected in the residential area in 2013. It was found that at certain locations the level of TCE present in the soil gas had not decreased. Two soil gas samples demonstrated an increase in the concentration of TCE, while three other soil gas samples demonstrated a decrease. The soil gas plume continues to be stable despite the fact that the groundwater plume has substantially decreased in size and concentration. Therefore, it appears as if historic, residual contamination continues to be "trapped" within the small spaces of the soil. This contamination then volatilizes into the soil gas. EPA is proposing additional off-site residential SSDSs to both protect the residents from potential vapor intrusion and to facilitate the remediation of the soil gas. This will be discussed in more detail later. The off-site, residential indoor air and soil gas data from 2009-2013 can be seen in Tables 1 and 2, below.

In March 2012, indoor air and sub-slab soil gas sampling at the on-site PRR industrial building was conducted. The initial vapor intrusion evaluation at the PRR building included monitoring VOC concentrations in indoor air from seven areas of the building, seven sub-slab monitoring locations, and an ambient air location outside the building. The results from this initial sampling indicated TCE exceedances in indoor air and soil gas, but not in the ambient air. The on-site indoor air and soil gas data are provided in Tables 3 and 4, below.

EPA directed PRR to increase ventilation to the building as an initial response to the indoor air results. Post-ventilation monitoring indicated ventilation reduced TCE concentrations in indoor air, but the concentrations continued to exceed the regional screening level at certain locations during some sampling events. Based on the elevated concentrations, PRR proceeded with an interim measure to reduce concentrations quickly. A building inspection was conducted and a program to identify and seal all visible cracks and preferential pathways has been implemented. The former SVE system, which had infrastructure beneath the building, was converted to an SSDS. The SSDS began operating in the summer of 2012. Figure 11 shows the locations of the soil vapor extraction wells (SVE wells) that remove vapors from beneath the building. Concentrations have continued to decrease; however, some areas of the building continue to exceed TCE screening criteria.

Additional actions to further reduce the indoor air concentrations have included: the installation of an additional SVE well to achieve more capture by the SSDS; installation of a larger blower on the SSDS; repairs to the existing air conditioners to ensure air flow is optimized; operating the building's positive pressure ventilation system 24-hours per day, rather than only during the work day; and, continued sealing of floor cracks as they are found. Operation and continued optimization of this SSDS is a component of the proposed remedy presented later in this document.

The tables below present the sampling results for both off-site and on-site vapor intrusion and soil gas investigations. Tables 1 and 2 present the off-site, residential data. “Indoor air” samples are collected inside the building within the breathing space. “Sub-slab soil gas” samples are collected from the space directly beneath the building foundation. "Soil gas" samples are collected from areas within the residential area, but not from directly beneath a building. These samples are collected from 'right-of-way' areas (such as streets and sidewalks) to help determine the overall location of the contaminated soil gas. Tables 3 and 4 present the on-site, industrial building data for both the sub-slab and indoor air before and after the SSDS was installed.

Table 1
Off-Site, Residential Vapor Intrusion Data 2009: Indoor Air and Sub-slab Soil Gas

Property[1]	Date Sampled	TCE Indoor Air[2] Results (ug/m^3)	TCE Sub-Slab[3] Results (ug/m^3)
1	4/1/09 8/5/09	ND[4] 0.27	ND ND
2	4/8/09 8/5/09	0.057 0.26	ND ND
3	4/1/09 7/23/09	ND 0.14	ND ND
4	4/8/09 8/7/09	0.47 0.80	330 260
5	4/1/09 8/5/09	0.029 0.20	ND ND
6	4/1/09 7/22/09	0.35 0.62	410 270

7	4/1/09 9/24/09 10/28/09 12/3/09	2.3 6.7 0.27 0.09	1600 UN[5] 20 7.3
8	4/14/09	0.68	200
9	4/14/09 8/5/09	0.27 0.32	81 27
10	4/1/09 8/7/09	0.10 0.21	26 7
11	4/8/09 8/5/09	0.23 0.18	80 24
12	4/8/09 7/22/09	0.79 0.99	2.6 ND
13	4/1/09 7/22/09	0.25 0.33	ND ND
14	4/1/09 8/5/09	0.038 0.19	ND ND
15	4/8/09 7/22/09	0.36 0.56	ND ND
16	4/2/09 8/6/09	0.042 0.2	ND ND
17	4/1/09 7/22/09	0.11 0.43	ND ND
18	4/2/09 7/23/09	0.042 0.32	ND 2.2
19	4/9/09 7/22/09	0.26 0.87	24 24
20	4/2/09 8/7/09	0.61 0.82	ND ND

Notes:
All data presented in micrograms per cubic meter
1. Property addresses retained for privacy
2. USEPA Regional Screening Level for Residential Indoor Air adjusted for target risk of $1x10^{-5}$ and target hazard quotient of 1 for TCE: 2.1 ug/m^3
3. TCE Sub-Slab Screening Level: 21 ug/m^3
4. ND=Not detected
5. Result not available due to sampling or laboratory error.
TCE in the outdoor, ambient air in April, July, and August 2009 was not detected.

Table 2
Off-Site, Soil Gas Samples 2013: 'Right-of-Way' Soil Gas

Compound	Soil Gas Screening Level[1]	VMP-16R[2]	VMP-17R	VMP-19R	VMP-21R	VMP-23R
Trichloroethene	70	1,210	165	<0.74	<0.74	1.1
cis-1,2-dichloroethene	2,100	31.5	<1.2	<1.1	<1.1	<1.1
trans-1,2-dichloroethene	2,100	1.4	<1.2	<1.1	<1.1	<1.1
1,1-dichloroethane	500	2.3	<1.2	<1.1	<1.1	<1.1
Vinyl Chloride	53	<0.36	<0.37	<0.35	<0.35	<0.35

Notes:
All data presented in micrograms per cubic meter
1. USEPA Regional Screening Level for Residential Indoor Air (USEPA, November 2012), adjusted for target risk of 1×10^{-5} and target hazard quotient of 1, and an attenuation factor of 0.03.
2. VMP: Vapor Monitoring Port, the location where the soil gas sample was collected.

Table 3
On-Site, Industrial Vapor Intrusion Data March 2012: Sub-Slab and Indoor Air *Before* SSDS

Building Area	TCE Indoor Air[1] Results (ug/m^3)	TCE Sub-Slab[2] Results (ug/m^3)
PRR Office	17	1,000
J.M.T	39	1,800
S. Rec. Park	20	14,000
Quality Trucking	30	33,000
Velthouse Antiques	28	32,000
Michigan Precision	8	8,500
N. Rec Park 1	20	670
N. Rec Park 2	18	29,800

Notes:
All data presented in micrograms per cubic meter
All sample results exceed the screening levels
1. USEPA Regional Screening Level for Industrial Indoor Air, adjusted for target risk of 1×10^{-5} and target hazard quotient of 1 for TCE is **8.8 ug/m^3**
2. TCE Sub-Slab screening level: **293 ug/m^3**

Table 4
On-Site, Industrial Vapor Intrusion Data 2014: Sub-Slab and Indoor Air *After* SSDS

Building Area	Date Sampled	TCE Indoor Air[1] Results (ug/m^3)	TCE Sub-Slab[2] Results (ug/m^3)
PRR Office	10/2013	0.83	578
	3/2014	<0.96	117
	6/2014	1.8	370
	9/2014	3.0	300
J.M.T	10/2013	<0.85	0.81
	3/2014	4.1	<0.79
	6/2014	1.7	4.3
	9/2014	4.1	33.8
S. Rec. Park	10/2013	<0.74	156
	3/2014	<0.74	58.7
	6/2014	<0.89	67.8
	9/2014	2.6	767
Quality Trucking	10/2013	<0.79	UN[3]
	3/2014	<0.79	2,240
	6/2014	2.4	452
	9/2014	1.8	5,020
Velthouse Antiques	10/2013	1.5	990
	3/2014	4.1	1,920
	6/2014	<0.92	533
	9/2014	2.9	2,400
Michigan Precision	10/2013	2.9	342
	3/2014	<0.74	132
	6/2014	<0.89	82.3
	9/2014	3.3	731
N. Rec Park 1	10/2013	<0.76	1.9
	3/2014	2.5	45.4
	6/2014	1.4	234
	9/2014	2.5	258
N. Rec Park 2	10/2013	<0.74	15,300
	3/2014	0.82	<0.74
	6/2014	<1.0	<0.89
	9/2014	<1.8	3.1

Notes:
All data presented in micrograms per cubic meter for the most recent four quarters
1. USEPA Regional Screening Level for Industrial Indoor Air, adjusted for target risk of $1x10^{-5}$ and target hazard quotient of 1 for TCE is 8.8 ug/m^3
2. TCE Sub-Slab screening level: 293 ug/m^3
3. Result not available due to sampling or laboratory error.

Soil

All potential historical soil source areas, as shown on Figure 2, have been investigated for contamination, including: solvents, metals, semi-volatile compounds, and polychlorinated biphenyls (PCBs). VOCs have been detected previously in the soil at the OSSR, OBP, API Separator, pit degreaser area, north gate, and cooling water retention lagoons. Metals have been detected previously in soil at concentrations above MDEQ statewide background levels at the OSSR, OBP, FBRA, and pit degreaser area. PCBs were not detected at the site.

As discussed above in the *Interim Measures* section, over 6,500 cubic yards of metals-contaminated soil have previously been excavated and disposed of off-site. Soil was addressed through excavation and off-site disposal as an interim measure when concentrations above screening criteria were discovered. Since the implementation of the interim measures, seventy soil samples have been analyzed for total metals, twenty-one were analyzed via the Toxicity Characteristic Leaching Procedure test, and twenty-three were analyzed for copper at the former furnace brick disposal area. Of these, fifteen had detections of metals above the Part 201 default background criteria or the criteria for protection of residential groundwater. One sample, located beneath the building slab, had an arsenic concentration above the Part 201 direct contact criterion.

The risk assessments conducted did not find an unacceptable risk associated with the metals on site at the concentrations detected, under the industrial land reuse scenario. The single sample with a concentration of arsenic greater than the direct contact criterion is located below the PRR building foundation; safe access for excavation does not exist at this time and is not necessary based upon the risk evaluation.

The TCE concentrations in soil have decreased significantly over time due to the treatment provided by the on-going pump and treat, historic SVE/AS systems, and ERD activities. The highest TCE concentration reported in the historical soil data (not including data from soil that was subsequently excavated and removed from the site) was 9,500,000 µg/kg; this same location, inside the OSR, was re-sampled in 2008 and a TCE concentration of 110 µg/kg was obtained. This comparison illustrates the generally successful reduction of TCE in the on-site soil through the SVE remediation efforts. Table 5 below provides additional sampling points where similar TCE reduction has been observed over time.

When the SVE system was initially placed into operation in 1994 the system was recovering TCE from the soil at rates exceeding 100 pounds per day, but by late 2007 the extraction rate had declined to generally less than 0.5 pounds per day with most of the individual soil gas samples having no TCE concentrations above the laboratory detection limits (*see* Figure 12).

The following tables provide key soil information. Table 5 demonstrates the general effectiveness of the interim measures in reducing TCE concentrations at co-located sampling points. It shows that at 13 discreet sampling locations, TCE concentrations were significantly reduced over time. The dates cover a range of sampling events that have taken place from the 1980's through the 2000's.

Table 6 provides the maximum detected concentrations of metals contaminants in site soils compared to screening criteria. These maximum concentrations represent the original site conditions, not the current day conditions. Interim measures have largely eliminated soil impacts above unacceptable risk. Due to the volume of sampling data, this table does not contain each individual sampling result from the 1980's through current day, but summarizes the site-wide maximum concentrations. Site-related VOC's, including TCE, have decreased significantly in soil, as shown in Tables 5 and 7. The most recent maximum concentration of TCE in on-site soil is 420 ug/kg, collected in 2008; however, as demonstrated by the soil gas samples presented in Tables 3 and 4, TCE in soil continues to be a source of vapors.

Table 5
TCE Concentration Trends at Co-Located Sampling Points

Source Area	Depth Range Feet Below Ground	Boring and Date	TCE ug/kg
Oil & Solvent Room: Center	15-19	OS-12: 1983 G-12: 1995	550,000 <5
	20-24	OS-6: 1983 08-G1: 2008	9,500,000 110
Oil & Solvent Room: North	19-22	OS-10: 1983 G-11: 1995 SB-4: 2002	210,000 5 <50
Oil & Solvent Room: West	15	OS-15: 1983 08-G2: 2008	170,000 <56
Main Degreaser: South	4-10	D-9: 1983 02-251: 2002 08-G4: 2008	230,000 4,200 51
	17-19	02-251: 2002 08-G4: 2008	6,000 98
Main Degreaser: North	0-10	83-2: 1983 G-16: 1995 SB-10: 2002	860 <5 <50
	15-22	83-2: 1983 G-16: 1995 SB-10: 2002	120 <5 170
Main Degreaser: West	7-8	02-254: 2002 08-G3: 2008	2,300 <54
Main Degreaser: Center	5-10	D-4: 1983 02-260: 2002 CP-6: 2002	470,000 420 690
Former Lagoon: East	5-10	G-21: 1995 08-G5: 2008	1,360 <56
	12-15	G-21: 1995	1,230

		08-G5: 2008	420
Former Lagoon: North	10-20	SB-11: 2002 08-G6: 2008	630 <56

Table 6
Soil Summary Data: Site-Wide Maximum Metals Concentrations

Compound	Maximum Reported (mg/kg)	MDEQ Part 201 Drinking Water Protection	MDEQ 201 Direct Contact Industrial
Arsenic	12	5.8	37
Barium	52	1,300	130,000
Cadmium	4.5	6	2,100
Copper	19,000	5,800	73,000
Lead	90	700	900
Mercury	0.17	1.7	580
Nickel	34	100	150,000
Silver	8.4	4.5	9,000
Zinc	475	2,400	630,000

Table 7
Soil Summary Data: On-Site Maximum Volatile Organic Compounds

Compound	2002 Maximum Reported (mg/kg)	2008 Maximum Reported (mg/kg)	MDEQ Part 201 Volatization to Indoor Air Inhalation (mg/kg)
TCE	6,700	420	1,900
Cis-1,2-DCE	310	Not Detected	41,000
1,1,1-TCA	270	Not Detected	460,000
1,1-DCA	95	Not Detected	430,000

Groundwater

The site's groundwater has been assessed for various contaminants including VOCs, semi-volatile organic compounds (SVOCs), 1,4-dioxane and metals. VOC constituents related to former solvent use at the plant have been identified in the groundwater, and remediation efforts have been underway since 1985 to capture and treat contaminated groundwater and prevent further migration. VOCs detected in the groundwater include: TCE; 1,1,1-trichloroethane; cis- and trans-1,2-dichloroethene; 1,1-dichloroethane; 1,1-dichloroethene, and vinyl chloride No other constituents have been detected in groundwater above applicable screening levels.

Site-wide comprehensive assessments of vertical and horizontal VOC impacts were completed in 1984, 2002, and 2005. Based on these assessments and the ongoing groundwater monitoring program, VOC concentrations and the horizontal extent of groundwater impacted by VOCs have decreased. The decreased concentrations can be attributed to the interim measures described above, as well as natural attenuation. Reductive dechlorination is naturally occurring at the site due to bacterial processes (subsurface microbes alter the contamination by using it for energy and producing harmless by-products, such as carbon dioxide). The reduction in horizontal extent of groundwater impact in the upper aquifer is illustrated in Figures 13-15 for 1983, 2004, and 2013. The overall reduction in VOCs, specifically TCE, can be cross-referenced with Figure 8. Figure 8 shows the pounds of TCE per day treated by the various remedial actions. The color coding corresponds to specific remedial technologies. For example, the green bar representing the air sparge/soil vapor extraction in the year 2000 treated approximately 90,000 pounds of TCE per day.

EPA's policy is to return aquifers back to their most beneficial use to the extent practicable. As such, the proposed final remedial endpoint for groundwater at this Facility is the federal Maximum Contaminant Levels (MCLs), which designate water safe for consumption. The groundwater in this area is not currently used for drinking water and future access is restricted by Institutional Controls. Based upon the behavior of chlorinated solvents released into the environment, however, this is considered a reasonable long-term goal. EPA is also establishing GSI criteria as intermediate cleanup endpoints. These two endpoints, intermediate and long-term, will be established with distinct points of compliance and decision criteria. The GSI points of compliance will be located upgradient of the interface discharge to receiving surface waters. The decision criteria associated with GSI compliance over time will be the systematic shut down of specific groundwater pumping wells (described in more detail later). This management plan will allow potential development of more environmentally friendly remedial methods, while ensuring potential receptors are being protected. Shutting down the purge wells will also help restore natural hydrology to the off-site wetland areas.

Current groundwater concentrations are summarized in Table 8 below. Well locations can be cross-referenced with Figure 11. The wells presented in Table 8 are representative of the leading edge of the plume. The plume has demonstrated a reduction in size and contaminant concentrations through time as depicted in Figures 13-15. Concentrations found are compared to MDEQ Part 201 GSI screening levels and the MCL screening levels. Note, however, that there is no current consumption of this impacted groundwater nor is such likely in the future due to Institutional Controls (*i.e.,* City Ordinance and deed restrictions).

Table 8
Groundwater Summary Data 2014: Volatile Organic Compounds

Well	TCE (ug/L)	Cis-1,2-DCE (ug/L)	Vinyl Chloride (ug/L)
	GSI Screening Level: 200 MCL Screening Level: 5	GSI Screening Level: 620 MCL Screening Level: 70	GSI Screening Level: 13 MCL Screening Level: 2
83-17B	53	37	<1
83-19A	5.8	1.3	<1
83-19B	150	30	7.1
83-21B	57	13	<1
98-224B	210	17	<2
98-245A	250	16	<2.5
02-02	230	11	4.6
06-17A	120	7	12
06-17B	330	33	5.4

Surface Water

The conceptual site model for the Prairie Ronde Realty site suggests that shallow groundwater potentially discharges to surface water and seeps along Pine Lake Drain to the east and to an unnamed drain to the west of the Facility. This discharge potential is based on groundwater gauging activities and historic contamination documented in the surface water of the unnamed drain. Contamination attributable to the site was not found above screening criteria in any of the other surface water bodies and sediments.

The surface water in the unnamed drain (generally just a few inches deep) had TCE levels above the GSI criterion when it was initially investigated in 1983/1984 with concentrations as high as 5,000 ug/L. TCE levels in surface water in the unnamed drain have been below the 200 ug/L GSI criterion since at least 2000. Surface water in the drain was sampled at two locations in 2000 and 2001 during regular quarterly monitoring events, and nine locations in 2002. It was re-sampled in April 2007 at two locations, and all VOC concentrations have consistently been below detection limits. As discussed above, GSI groundwater monitoring wells remain in place to continue to measure whether the GSI standard for TCE is met at the established points of compliance (*see* Figure 5).

SUMMARY OF FACILITY RISKS

Human Health Risks

The human health risk assessment (HHRA) evaluated risks associated with soil, groundwater and surface water. Separate risk evaluations were conducted for the vapor intrusion pathways both on- and off-site. Potential human health risks associated with current uses of soil, groundwater and surface water are within EPA's acceptable range. For all exposure pathways evaluated, the HHRA documented pathways are either not complete or the concentrations at the exposure point are lower than applicable risk-based criteria. It is anticipated that the site will remain in use for industrial or commercial purposes, consistent with the Restrictive Covenant filed for the property in 2009 (see Attachment 3).

Risks associated with exposure to residential indoor air were found to be potentially unacceptable at one house based on the sampling results of the off-site vapor intrusion investigation. A SSDS was installed at that house. Confirmatory indoor air monitoring at the house confirmed that the risks associated with indoor air are acceptable after the installation of the SSDS.

Risks associated with exposure to indoor air at the on-site PRR building were found to be potentially unacceptable based on sampling results from the on-site vapor intrusion investigation. The former SVE system was converted to a SSDS at the building and ventilation of the building was increased to mitigate exposure to chemicals in the PRR building's air. These interim measures have reduced concentrations of contaminants in indoor air, but the potential risks are still not entirely in the acceptable range and mitigation is continuing.

In addition to the conservative risk assessments described, land use controls will be used to ensure human health is protected. There is currently no known use of impacted groundwater for drinking water purposes. A Restrictive Covenant is currently in place to prevent future use of the facility that is inconsistent with the risk assessment assumptions. The covenant provides the following protections: ensures the land is maintained for industrial use (prohibiting residential redevelopment); prohibits the use of groundwater as a drinking water source or any use that would result in human contact; prohibits the use of chlorinated solvents at the Facility; requires any new structure built at the site is equipped with a vapor mitigation system; and requires the on-going operation and maintenance of existing remedial mitigation systems. Last, in the event facility or construction workers need to excavate soil on-site, an appropriately protective Health and Safety Plan will be required.

A local City Ordinance (Dowagiac City Zoning Ordinance) requires new construction to be served by the public water supply or for the water supply to be approved by the County Health Department. Amendment of this City Ordinance to specifically address the site contamination consistent with MDEQ guidance is being pursued. There are presently no specific restrictions on using groundwater outside the City; however, that portion of Wayne Township with impacted groundwater is zoned for "Open Space and Recreation" and groundwater is not used for drinking water in the impacted area. Deed restrictions or other institutional controls consistent with

MDEQ guidance are also being pursued for the potentially affected off-site properties in the Township.

The HHRA conclusions concerning current risks are presented below:

1. Soil protection for groundwater: Certain soil samples, primarily under the PRR building and at the former FBRA and OBP areas, contained metals at concentrations exceeding the groundwater protection criteria for soil. This exposure route is not currently complete because metals have not been detected above screening criteria in the groundwater and impacted groundwater is not used for drinking water.

2. Residential ingestion of groundwater outside of the PRR property: Contaminant concentrations in groundwater exceed drinking water criteria. The impacted areas off-site where residential structures are present are receiving drinking water from the municipal supply, not groundwater. All new construction within the City limits would be required to connect to and receive City water. The area of groundwater impact outside PRR property and beyond the City limits resides within Wayne Township. The area of the Township with potential impacts is zoned as "Open Space and Recreation" and consists mostly of wetland-type land and there is no use of groundwater. The potential human health risks associated with ingestion of groundwater are currently acceptable because there is no complete exposure pathway.

3. Groundwater ingestion on the PRR property: A Restrictive Covenant is in place to prohibit groundwater use on the PRR property for drinking water. Potential human health risks associated with ingestion of groundwater are acceptable because there is no complete exposure pathway. Drinking water wells do not exist on the PRR property.

4. Groundwater dermal contact (residential and non-residential): Contaminant concentrations were less than dermal contact criteria in all wells included in the third quarter 2011 monitoring event. Vinyl chloride concentrations exceeded the groundwater dermal contact criterion in the third quarter of 2012 in two wells on the PRR property where a compound to enhance anaerobic conditions and biodegradation was injected as part of the ERD pilot study. (This temporary increase was an anticipated byproduct of the in-situ treatment testing). This exposure pathway is incomplete, however, because on-site groundwater is prohibited for any use that would result in human contact. The potential risk associated with this pathway is acceptable.

5. Soil direct contact: One sample (sample #02-254), out of the twenty samples collected from beneath the PRR building and analyzed for arsenic had an arsenic concentration slightly exceeding the non-residential criterion for direct soil contact. The 95% upper confidence limit of the mean arsenic concentration in this area was less than the direct soil contact criterion, resulting in acceptable risk. This means that most of the soil surrounding the single arsenic exceedance did not exceed the acceptable screening level. This exposure pathway is presently incomplete because the location of the single concentration that exceeded the criterion is under the building and not accessible. The risks associated with direct contact with soil are acceptable.

6. Surface water ingestion and direct contact: Concentrations of contaminants of concern in the surface water were less than the applicable criteria except at one seep, SP-5. The vinyl chloride

concentration at SP-5 collected in 2002 was 17 ug/L, slightly more than the 15 ug/L MDEQ GSI criterion in effect at that time. SP-5 was resampled in September 2009, and the vinyl chloride (VC) concentration was 15 ug/L, but the GSI criterion was subsequently changed by MDEQ to 13 ug/L. SP-5 was sampled again in February and March 2012, and the VC concentrations were 19 and 21 ug/L, respectively. Surface water is not always present at SP-5 and when present forms a small puddle. The GSI criterion is based on human exposure by partial body contact activities such as swimming, which are not possible at SP-5. SP-5 is also difficult to access. This exposure pathway/route is not complete due to the small size, intermittent presence and seep location. EPA believes the risks associated with surface water ingestion and direct contact are acceptable. These concentrations will continue to be monitored and are also expected to be reduced over time as the final remedy is implemented.

7. Other groundwater uses: The HHRA also evaluated potential human health risks associated with using groundwater for aquaculture at a nearby residence. The groundwater at this residence is used for rearing bait minnows. The estimated contaminant concentrations in indoor air were less than screening levels for residential indoor air (2.1 ug/m3). Using groundwater for raising bait minnows is not predicted to result in unacceptable risks to human health.

EPA requested an additional evaluation regarding the impact of using groundwater for flushing toilets and washing, based upon a home known to use groundwater for those purposes (PRR has repeatedly offered to provide City water to the home). The same model was used to evaluate impacts on indoor air associated with using groundwater for flushing and washing as was used for evaluating aquaculture impacts on indoor air. Input parameters were changed to reflect domestic groundwater use for toilets and wash water. The estimated contaminant concentrations in indoor air associated with using groundwater for flushing toilets and washing were less than EPA screening levels. Using groundwater for flushing toilets and washing is not predicted to result in unacceptable risks to human health.

8. Indoor Air: Indoor air exposure was evaluated at both off-site residential homes and at the on-site industrial building during the soil gas and vapor intrusion investigations. Seven of the twenty homes in the off-site investigation had sub-slab soil gas sample results above the applicable screening criteria. All twenty homes were sampled for indoor air exceedances, following a "multiple lines of evidence" approach. One home had an indoor air sampling result slightly in exceedance of the screening criteria. The indoor air result was 2.3 ug/m3 and the screening criterion is 2.1 ug/m3. This home also had the highest sub-slab soil gas sampling result; therefore, a mitigation system was installed at this home (SSDS). Follow-up sampling has confirmed that this home no longer has any screening level exceedances and this exposure pathway has been eliminated through the use of the SSDS. As previously discussed, however, EPA is proposing additional SSDSs in the residential area. Although there is currently no risk to off-site indoor air, this long-term protective strategy ensures receptors are not impacted sometime in the future from the high concentrations of TCE in the sub-slab soil gas.

The vapor intrusion investigation of the on-site industrial building demonstrated unacceptable exceedances of TCE in both the sub-slab and the indoor air. The building was immediately ventilated to reduce the indoor air concentrations. A preferential pathway survey was then conducted throughout the building to seal and patch foundation cracks or utility corridors. The former SVE system was converted to an SSDS. The operation of the SSDS has reduced TCE concentrations in the indoor air to acceptable concentrations. The system will continue to be used as a vapor intrusion mitigation system and will be upgraded as needed to achieve soil remediation.

Ecological Risks

Ecological risks were evaluated in the ecological risk assessment. For all exposure pathways evaluated for ecological receptors, the pathways were identified as being currently incomplete or contaminant concentrations are less than ecological screening levels. Therefore, ecological risks are within acceptable ranges.

The ecological risk assessment uses approaches and criteria deliberately intended to ensure risk is conservatively evaluated. The uncertainty inherent in the assessment suggests the risk of adverse effects to potentially exposed ecological receptors is overestimated. Future risks are likely to be less than current risks as concentrations in groundwater continue to decrease.

The ecological risk assessment made the following conclusions:

1. Sensitive receptors including amphibians and Mitchell's satyr butterfly were evaluated through the use of protective, conservative screening values. Exposures from venting groundwater, surface water, groundwater, and soil were evaluated. Soil from within the primary conservation zone for the butterfly was specifically evaluated. The risk assessment concluded that there is no unacceptable risk from the site contamination to these sensitive receptors.

2. In the wetlands north of the Facility and in the lake and associated drains there is no unacceptable ecological risk from impacted groundwater discharge. Contaminant concentrations in shallow groundwater discharging to surface water do not exceed screening criteria.

3. There are no unacceptable risks to receptors related to the site within the lake or drain sediment or surface water.

4. There are no unacceptable risks to receptors related to the site within the wetlands located north/northwest of the Facility.

SCOPE OF CORRECTIVE ACTION

The proposed final remedies and associated remedial goals are designed to protect human health and the environment by mitigating risk to current and potential future receptors. Presented below are the proposed remedial goals for the affected media on- and off-site.

Groundwater

The groundwater at the site has been contaminated with VOCs, specifically TCE and its breakdown products, dichloroethene (DCE) and VC. The proposed groundwater remedial strategy includes both intermediate and final remedial goals; the MDEQ GSI protection criteria and the Federal Clean Water Act MCLs, respectively. The proposed remedy achieves these goals through the use of the existing groundwater pump and treat system, the in-situ enhanced reductive dechlorination with bioaugmentation, and monitored natural attenuation.

The Facility is located immediately upgradient from Pine Lake and its associated tributaries and wetlands. The current groundwater pump and treat system has been in operation since the 1980s and is currently pumping approximately 250 gallons of water per minute. The impact of pumping such a large quantity of groundwater is a depression in the natural hydrologic regime that feeds the wetland areas, considered a valuable ecological habitat. The proposed intermediate remedial goal is designed to protect downgradient surface water bodies and receptors through the pump and treat system. EPA believes this allows other remedial mechanisms to produce further reductions in order to reach the final remedial goal of MCLs. The two remedial goals represent a remedial strategy intended to protect all potential current and future receptors. A short-term use of the current pump and treat system will protect surface water and allow time for implementation of other more effective groundwater remediation actions that can remove contamination to safe drinking water standards. The following section will provide more detail on the proposed implementation alternatives.

<u>Soil/Soil Gas-to-Indoor Air</u>

Interim measures taken, including excavation, soil vapor extraction, and air sparging, have reduced the volume of historical source material in the soil. The remaining contamination in the soil on-site is located under the plant building. Further direct soil removal is not a feasible option due to concerns about the integrity and safety of the building. However, EPA believes addressing the remaining source material as it partitions between the groundwater and the soil gas phase will reduce contaminant concentrations and help remediate the impacted soil beneath the building. Remedies for groundwater and soil gas are described in more detail below.

The on-site building currently used for commercial purposes has TCE in the sub-slab soil gas in exceedance of EPA's Regional Screening Levels (industrial). A complete vapor intrusion pathway was discovered when the indoor air was sampled within the building in 2012. An SSDS was installed and has stopped the migration of vapors into the building at industrial levels, therefore eliminating that exposure pathway. The SSDS acts as a vapor barrier to protect on-site receptors from indoor air exceedances. EPA proposes that the SSDS will operate as a vapor barrier and soil remediation system until such time the sub-slab soil gas concentrations are found to no longer pose an unacceptable risk without the SSDS. That sub-slab soil gas metric for TCE is 293 ug/m3 (using a default attenuation factor of 0.03). Appropriate sampling frequency and rebound test procedures must be established in the Corrective Measures Implementation Work Plan.

The off-site soil gas and vapor intrusion investigations conducted by PRR evaluated the indoor air and sub-slab TCE concentrations at residences adjacent to the Facility. In general, the investigations demonstrated that the soil gas remains impacted by the historic TCE contamination (*see* Figure 16). Area-wide soil gas samples and sub-slab samples showed elevated concentrations of TCE in certain areas and beneath some homes. However, the indoor air sampling results from 2009 demonstrated that the vapor intrusion pathway is largely not complete. TCE was below the residential screening criteria at all homes with the exception of one home.

At the one residence, an indoor air TCE concentration of 2.3 ug/m^3, slightly above the EPA screening criteria of 2.1 ug/m^3, was found. PRR installed an SSDS at that home in 2009 to eliminate that exposure pathway by reducing indoor air concentrations of TCE and follow-up samples confirmed that the SSDS has done that. Despite the fact soil gas was not found at unacceptable levels in the other homes, EPA is proposing as part of this final remedy that PRR install SSDSs in ten (10) additional homes within the area of impacted soil gas. In light of the persistently elevated concentration of TCE in the off-site soil gas, this risk management decision is intended to protect receptors in the future. There are many variables that contribute to the vapor intrusion pathway and the Agency believes this proactive approach accounts for those variables in the future.

Overall, EPA believes it is important that the remedial strategy accomplish the following:

- Protect downgradient surface water bodies by assuring that the points of compliance, established by EPA, meet the GSI criteria through the operation of the existing pump and treat system.
- Address the contamination in deeper source areas by using in-situ mechanisms, such as ERD and bioaugmentation, to treat VOCs.
- Address the contamination in the shallower source areas that present vapor intrusion risks through the operation of SSDSs at the on-site building and nearby residences.
- Protect current and potential future receptors from exposures to groundwater or soil that present unacceptable risks through institutional controls.

SUMMARY OF ALTERNATIVES

To address the issues identified at the PRR site, this Statement of Basis considers the following actions: a "no action" alternative, the use of institutional controls, and one or more of four engineered controls that can be applied to the site. The engineered controls include: groundwater pump-and-treat, SSDS, ERD with bioaugmentation, and MNA. Evaluating these alternatives includes a feasibility screening to assess the applicability and compatibility of the technology with the site's contamination and physical characteristics. The following is a brief description of each alternative considered (*also see* Attachment 2):

No Action

The "no action" alternative is a baseline against which all other alternatives are considered. It would include terminating any remedial work currently taking place and eliminating any possible future work or long-term monitoring. The Agency evaluates all remedial alternatives against this baseline; however, it is not an appropriate alternative to be adopted for this site.

Institutional Controls

Institutional controls include legal deed restrictions or restrictive covenants, zoning ordinances, and other non-physical methods of preventing or reducing access and exposure to contamination that may result in potentially unacceptable risks for human health and the environment.

Deed restrictions in general are land and water use restrictions filed with the registrar of deeds for the local governing body. These restrictions can provide a means to make the current and future property owners aware of impacts present at the property, in the soil or groundwater.

At the PRR site, institutional controls alone will not prevent contaminated groundwater from migrating, however, institutional controls can effectively be used in conjunction with other options to protect potential receptors until other corrective measures achieve the corrective measure goals. Therefore, using institutional controls as a corrective measure will be retained for further evaluation in conjunction with other treatment technologies.

An existing Restrictive Covenant (*see* Attachment 3) for the PRR property currently provides the following protections: limits the future use of the property to industrial, warehouse and/or appropriate commercial purposes; restricts groundwater and surface water use; requires the appropriate operation and maintenance of all remedial systems; and requires vapor intrusion protection for new structures. Existing zoning ordinances also limit the potential uses of the Facility and downgradient properties, and requires new off-site structures to use the City's public water supply.

Implementation of Institutional Controls as a corrective measure requires the completion of an environmental covenant document to be approved by EPA. As part of the Corrective Measures Implementation process, EPA will also require a five-year Institutional Controls Certification to be submitted to the Agency. The certification is intended to track institutional controls and ensure they are being appropriately maintained and applied through time.

Monitored Natural Attenuation (MNA)

MNA requires that the company monitor naturally-occurring processes that decrease contaminant concentrations to assure that natural processes are occurring. Biodegradation is defined as contaminants degrading by biological processes, and may be a dominant attenuation mechanism under certain circumstances. MNA also includes the non-biological processes of dilution, dispersion, adsorption and chemical transformation.

MNA differs from the “no action” alternative by including a pro-active groundwater monitoring program based on careful examination of hydrogeology, groundwater geochemistry, chemical mass and chemistry, natural microbial communities, and impacted groundwater contamination stability.

The feasibility of MNA considers the following evaluation factors:

- time to attain final goals compared to active remediation;
- proximity of contaminants to nearest receptor;

- stability of impacted groundwater area (will area of contamination expand?);
- presence of non-aqueous phase liquids; and
- presence of other sources or source controls.

The MNA alternative would require a carefully developed site-specific groundwater monitoring plan. Developing a MNA plan at the site would follow USEPA's *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* (USEPA, 1998). The chlorinated solvents at the PRR site, including TCE, are biodegraded under natural conditions via reductive dechlorination, a process that requires both electron acceptors (the chlorinated solvent) and an adequate supply of electron donors. Electron donors include natural organic carbon sources. During this process, the chlorinated solvent is used as an electron acceptor, not as a source of carbon, and a chlorine atom is removed and replaced with a hydrogen atom. In general, reductive dechlorination occurs by sequential dechlorination from TCE to DCE to VC to ethane, a harmless end-product. The naturally occurring microbe responsible for the dechlorination is called dehalococcoides, which has been confirmed to exist at sufficient levels at the PRR site. The MNA monitoring plan would include documentation of:

- presence of degradation daughter products;
- concentration of TCE and daughter products over time;
- geological characterization;
- microbial community and functional genes;
- contaminant area morphology/stability; and
- geochemistry.

MNA would not be effective at immediately stabilizing contaminated groundwater migration from the PRR property in order to control potential exposures; therefore, MNA would work most effectively paired with another source treatment and/or transport control option as a way of confirming the long-term achievement of corrective action objectives.

Groundwater Pump-and-Treat

Groundwater pump-and-treat system objectives are to remove and treat contaminated groundwater and prevent further migration of impacted groundwater. The extracted groundwater will pass through a treatment system, such as granular activated carbon or an air stripper, where the contaminants are removed from the purged groundwater, prior to discharge. Treated groundwater may be discharged to a nearby storm sewer, Publicly Owned Treatment Works, surface water or groundwater pursuant to an appropriate discharge permit. The treatment media are changed out and appropriately disposed of as necessary.

A pump-and-treat system has been in place at the Facility since 1984, and has been maintaining hydraulic control of the contaminated groundwater at the site. The current system has nine extraction wells. The system has the capacity to capture in excess of 1,000,000 gallons of groundwater per day and is currently pumping at approximately 250 gallons per minute. After capture, the extracted groundwater then passes through an air stripper for treatment. The treated groundwater is discharged to Pine Lake Drain pursuant to a National Pollutant Discharge Elimination System (NPDES) permit (Permit No. MI0003069). Pump-and-treat is an effective way of preventing the migration of contamination and will be considered further in this document.

Enhanced Reductive Dechlorination (ERD) with Bioaugmentation

ERD treatment involves adding a nutrient supplement to the groundwater to enhance contaminant degradation and decrease contaminant concentrations. Chlorinated VOCs, such as TCE, will degrade via anaerobic degradation. Anaerobic biodegradation includes naturally occurring bacteria in soils that use hydrogen to chemically reduce the contaminant (replaces a chlorine atom with hydrogen on a chlorinated solvent molecule). The process is also referred to as "reductive dechlorination."

The pilot study and proposed final remedy for this site include use of a reducing formula to promote anaerobic biodegradation of TCE in groundwater. The formula is a mixture of lactates, fatty acids, a phosphate buffer and zero-valent iron. The zero-valent iron included within this mixture chemically drives the rapid reduction of TCE, further promotes an anaerobic environment, and facilitates the biodegradation. The pilot study performed at the site showed ERD to be effective at reducing VOC concentrations in the groundwater and soil. Since the pilot test was proven to be effective, implementing a full-scale ERD alternative will be considered further in this document.

The naturally occurring biological organisms (bacteria) required to facilitate this reaction would be monitored along with the contamination. In the event the biological populations decrease below an optimal size for effective use as a treatment, bioaugmentation may be implemented to ensure adequate population size (adding additional organisms to the subsurface).

Sub-Slab Depressurization System (SSDS)

A SSDS is a vapor mitigation system that addresses the risk associated with soil vapor intrusion to indoor air. A SSDS uses a vapor collection system to capture vapors emanating from contaminated subsurface environmental media, either groundwater or soil, before they can enter a building. The SSDS acts as a vapor barrier to protect on-site receptors from unacceptable levels of indoor air contamination.

As part of this proposed remedy, the current SSDS operating at the on-site industrial building would remain in operation in accordance with the remedial goals discussed in previous sections. Additional SSDSs are being proposed for specific residential properties located over or within proximity to the known soil gas contamination. The current and proposed SSDSs will be considered further in this document in combination with other remedial alternatives.

Financial Assurance

Prairie Ronde Realty must demonstrate that adequate funds will be available to complete the construction as well as the operation and maintenance of all selected remedial activities, consistent with the requirements of 40 C.F.R §§ 264.142 and 264.144. PRR will develop a detailed, updated cost estimate as part of the corrective measures work plan, incorporating contractor bids of the EPA approved scope of work contained in the work plan for all selected remedies. PRR may use any of the following financial mechanisms to make this demonstration: financial trust, surety bonds, letters of credit, insurance, and/or qualification as a self-insurer (corporate guaranty) by means of a financial test. After successfully completing the construction phase of the remedy, PRR may request that EPA reduce the amount of the financial assurance to the amount necessary to cover the remaining costs of the remedy. PRR may make similar requests from time to time as the operation and maintenance phase of the remedies proceeds.

Five-Year Remedy Reviews

Five year reviews are intended to streamline the remedy through a series of assessments of the corrective measures and optimizing adjustments to the remedy, as necessary, which might also reduce overall costs and cleanup time frame and evaluate relevant remedial goals. The documentation of the review will contain, at a minimum, an evaluation of remedy effectiveness, an assessment of remedial timeframes, and any recommendations to optimize the system. The EPA proposes that PRR will conduct five year reviews until such time as the remedial endpoints are met or agreed to be satisfied.

If any of the five-year reviews indicate that changes to the selected remedy are appropriate, EPA would determine whether the proposed changes are non-significant, significant, or fundamental changes. EPA may approve non-significant changes to the corrective action without public comment. EPA would inform the public about significant or fundamental changes, and would hold a formal public comment period prior to making its decision about such changes.

Proposed Remedial Alternatives

The remedial alternatives described above have been considered either independently or in varying combinations for consideration as the proposed corrective measures alternative. Four alternatives have been considered and are described below. The following section will further evaluate these alternatives through a systematic weighting process.

Alternative 1: No Action

The "no action" alternative does not include active treatment or monitoring. This alternative is presented as a baseline for comparison to other alternatives. This alternative would involve turning off the existing groundwater pump-and-treat system, the existing SSDS, and ceasing all ERD treatments. Turning off the pump-and-treat system would allow natural groundwater flow conditions to resume and impacted groundwater would migrate from the PRR property. Turning off the SSDS would likely allow the vapor intrusion exposure pathway to be complete. The absence of ERD treatments would significantly reduce the rate at which TCE biodegrades in the groundwater. This alternative would not address the remaining source areas and the groundwater contamination present at unacceptable levels. It would also allow further migration of contamination.

Alternative 2: Monitored Natural Attenuation, Institutional Controls, Financial Assurance, and Five-Year Remedy Reviews

Natural attenuation of VOC concentrations is occurring at the site, as evidenced by the presence of degradation products of the contaminant of concern, TCE. As noted above, without further active corrective measures to address the remaining source areas, natural attenuation is not likely to achieve cleanup objectives in a reasonable timeframe. However, once contaminant levels have been reduced and additional source material has been removed or treated, MNA may be used to confirm that groundwater contamination will be reduced to acceptable levels.

The MNA alternative includes developing a site-specific MNA work plan, which would involve an update of the initial conceptual site model and groundwater monitoring. If, as expected, the updated model indicates natural attenuation is still occurring, then groundwater monitoring would be conducted to verify the subsurface conditions at the site continue to support natural attenuation. The updated model and groundwater monitoring plan would be developed using the USEPA's guidance document *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* (USEPA, 1998).

Financial assurance is also a component of this alternative. Prairie Ronde Realty must demonstrate that adequate funds will be available to implement the remedy and conduct operation and maintenance of the selected remedy. PRR will provide financial assurance based on the estimated cost of the corrective measures.

In addition, the performance and progress of the MNA and ICs will be reviewed every five years until such time the cleanup endpoints are met. The review will contain, at a minimum, an evaluation of cleanup effectiveness, an assessment of corrective action timeframes, and any recommendations to optimize the system.

Alternative 3: Pump-and-Treat, MNA, Existing SSDSs, Institutional Controls, Financial Assurance, and Five-Year Remedy Reviews

This alternative incorporates the elements of *Alternative 2*, above, but also includes active remediation of the contaminants on site by maintaining the current pump-and-treat system at the site and maintaining the current SSDSs.

The existing groundwater pump-and-treat system would be used to maintain hydraulic control of the impacted groundwater and prevent contaminant area expansion. The system would include the existing purge wells and the associated points of compliance wells with TCE concentrations greater than 200 ug/L, the GSI criterion. A groundwater monitoring program would be developed to include parameters for natural attenuation. Based on the MNA evaluation results, modifications to the pump-and-treat system may be proposed. Such modifications may include extraction rate changes at purge wells, adding new purge wells or turning off individual purge wells.

The existing SSD systems at the on-site industrial building and single residential structure would be maintained and would continue to act as a vapor barrier to protect receptors. The on-site

SSDS performance will be evaluated through sub-slab and indoor air monitoring. The indoor air must remain below the industrial screening level. The sub-slab soil gas metric that must be reached as an intermediate goal is 293 ug/m3 for TCE (this concentration corresponds with an acceptable indoor air industrial screening level of 8.8 ug/m3 with an attenuation factor of 0.03). Depending upon the comprehensive data (groundwater, soil, and soil gas, for example), the system operation may continue, cease, or proceed to a "pulsed" management plan for further mass reduction as system metrics are achieved.

The requirements detailed above for ICs, financial assurance, and five-year remedy reviews would be part of this remedy alternative.

Alternative 4: Enhanced Reductive Dechlorination (ERD), Bioaugmentation, Pump-and-Treat, MNA, On-Site and Off-Site SSDSs, Institutional Controls, Five-Year Remedy Reviews, and Financial Assurance

This alternative further expands the scope of the previous alternatives, including using ERD with bioaugmentation and the installation of additional off-site, residential SSDSs. The ERD and additional SSDSs would be coupled with: the pump-and-treat system, continued groundwater monitoring with MNA analysis, maintaining and evaluating the existing institutional controls, and the SSDSs currently in operation (described in more detail above). This alternative also includes five-year remedy reviews and financial assurance, also described under *Alternative 2*.

ERD was tested at the site in a pilot study and was found to be effective at reducing VOC concentrations in groundwater. The pilot study was performed in the former OSSR source area. Full-scale application at the site would include the other residual source areas. Full-scale design for the ERD application at the site would consider the results from the pilot study. A *Final Remedy Construction Work Plan* would be developed and submitted for approval by EPA.

In addition to maintaining the existing SSDS, 10 additional SSDSs are being proposed for off-site residential properties. Although the historic off-site indoor air data did not demonstrate vapor intrusion at these ten homes, the off-site soil gas has elevated levels of TCE. The levels have remained high and indicate a potential residual source of contamination within the soil pores. Installing SSDSs at those locations where soil gas is contaminated protects off-site residents in the future from potential vapor intrusion. If selected, this remedy will be detailed in a *Final Remedy Construction Work Plan.*

Continued groundwater monitoring would evaluate the ERD effectiveness at the site. The ERD evaluation would be completed according to approved work plans and would be summarized in groundwater monitoring reports.

Groundwater monitoring pursuant to the CAMP would also evaluate the treatment progress, and the flow from purge wells would be adjusted according to the monitoring data. It may also be possible to reduce the number of purge wells in operation after ERD is implemented.

Based on review of the monitoring data, the scope of some or all of the components may be adjusted to more effectively and efficiently achieve corrective action objectives. The MNA process may also lead to adjustments or modifications.

The Agency is putting forward Alternative 4 as the proposed remedy for the site. A proposed schedule for the implementation of this remedial alternative can be found in Attachment 4.

EVALUATION OF THE PROPOSED REMEDY AND ALTERNATIVES

EPA's threshold and balancing criteria will be used to determine the applicability of each remedial alternative in relation to the specific circumstances of the impacts defined at the site. Remedies attaining all four threshold criteria are then weighed against the balancing criteria.

Threshold criteria:
1. Overall protection of public health and the environment
2. Attain media cleanup standards (corrective measures goals)
3. Control hazardous substance sources and releases
4. Comply with standards for managing wastes

Balancing criteria:
1. Long-term reliability and effectiveness
2. Reduce toxicity, mobility, or waste volume
3. Short-term effectiveness
4. Implementability (technical feasibility and availability of services and materials)
5. State and community acceptance
6. Cost

Threshold Criteria

Overall Protection of Public Health and the Environment

This evaluation criterion assesses the extent to which each alternative achieves and maintains protection of public health and the environment. The alternative's ability to remove or minimize complete or potentially complete exposure pathways will also be assessed.

Alternative 1: No Action, will not protect public health and the environment or address all potentially complete exposure pathways.

Alternative 2: MNA with institutional controls, would not fully protect human health or address potentially complete exposure pathways. Even though the deed restriction would prevent exposure via groundwater ingestion or dermal contact at the PRR property, exposure risks via indoor air inhalation are not mitigated with Alternative 2. Alternative 2 also may not fully protect the environment since it is possible the area of contamination in groundwater would expand without pump-and-treat hydraulic controls operating. Elevated TCE and other VOC concentrations above the interim corrective measures goals could discharge into surface water bodies and MCLs would not likely be obtained in a reasonable period of time.

Alternative 3: Pump-and-Treat, MNA, SSDSs and Institutional Controls, would protect human health and the environment and address potentially complete exposure pathways. Operating the pump-and-treat system would control human and environmental exposure to impacted groundwater. Current indoor air exposures would be controlled with the SSDSs. However, potential future off-site vapor intrusion from the soil gas contamination would not be addressed under this alternative. Existing deed restrictions would prevent future exposure risks to soils and groundwater at the PRR property, and other institutional controls would mitigate other potential off-site exposures.

Alternative 4: Enhanced Reductive Dechlorination (ERD), Bioaugmentation, Pump-and-Treat, MNA, On-Site and Off-Site SSDS, Institutional Controls, Five-Year Remedy Reviews, and Financial Assurance, would, like Alternative 3, also protect human health and the environment and addresses potentially complete exposure pathways. Operating the pump-and-treat system would control human and environmental exposure to impacted groundwater. Both current and potential future indoor air exposure would be controlled with the SSDSs. The Institutional Controls would prevent future exposure risks to soils and groundwater at the PRR property and off-site. Furthermore, ERD would reduce the anticipated cleanup time at the site, and would, therefore, reduce the potential contaminant exposure time to the public and the environment.

Attaining Media Cleanup Standards (Corrective Measures Goals)

This evaluation criterion assesses the extent to which each alternative can attain media-specific final corrective measures goals.

Alternative 1: attaining final corrective measures goals is not expected by No Action because hydraulic control of groundwater would not be maintained to protect surface water, the source areas would not be addressed, and the aquifer would no longer be under enhanced reducing conditions to encourage dechlorination of the VOCs.

Alternative 2: attaining final corrective measures goals is not expected by MNA because hydraulic control would not be maintained and the source areas would not be addressed. MNA alone would allow the aquifer to return to oxidizing conditions, where co-metabolism of chlorinated solvents takes much longer to reduce the concentrations of VOCs, compared to reductive dechlorination. The groundwater contamination area would likely expand and the soil gas-to-indoor air exposure pathway would likely be complete. Institutional controls may limit or eliminate actual exposures.

Alternative 3: attaining final corrective measures goals is expected by this combination of remedial techniques. This alternative has a high probability of attaining remedial goals because the pump and treat system would continue to maintain hydraulic gradient while slowly encouraging the back-diffusion of VOCs out of the soil pore space and into the transmissive zone of pumping. MNA, over a long period of time, would demonstrate contaminant concentration reductions, and the SSDS would continue to mitigate inhalation risk while remediating the shallow residual soil pore space. This alternative would likely require a very long period of active remediation through pump and treat however, because of the difficulty in removing VOCs that become attached to finer-grain silty soil pockets.

Alternative 4: attaining final corrective measures goals is expected by this combination of remedial measures. This alternative has a high probability of attaining remedial goals in a more reasonable timeframe than Alternative 3. The pump and treat system would maintain hydraulic control to protect downgradient surface water bodies; the ERD and bioaugmentation would address the source areas by maintaining a reducing environment, encouraging biodegradation, and enhancing the back-diffusion process of NAPL from soil pore space; and, the on-site SSDS would be operated in such a way as to encourage shallow soil pore space volatilization of VOCs while mitigating indoor air risk. The combination of ERD and limited pump and treat would reduce the overall remedial timeframe.

Control Hazardous Substances, Sources, and Releases

This evaluation criterion assesses the extent to which each alternative can control hazardous substances, sources, and releases. There are no continued operations at the PRR property using VOCs, and potential primary sources (e.g., bulk soils, USTs, etc.) have been removed and properly disposed. Therefore, there is no potential for future VOC releases from primary sources or operations at the PRR property. Corrective measures alternatives 2, 3, and 4 meet the “Control the Sources and Releases” criterion. The remaining historical contaminant sources are soil and groundwater, which are secondary sources impacted by past releases from the primary sources. Alternative 4 is best suited to address these secondary sources because the inclusion of ERD would stimulate dechlorination and biodegradation of the VOCs and the on-site SSDS will further reduce mass in the shallow soil.

Comply with Standards for Managing Wastes

Any waste derived from corrective measures implemented at the site would be characterized and disposed in accordance with all applicable laws and regulations. All four remedial alternatives meet this criterion (although No Action would not generate any investigation or remedial wastes).

<u>Balancing Criteria</u>

The four corrective measures were evaluated and weighed first using the threshold criteria to assess how well each alternative meets project objectives. Corrective measures attaining all four threshold criteria are further weighed against the balancing criteria. Two corrective measures, Alternative 3 and Alternative 4, met all four threshold criteria and are discussed further using the balancing criteria in the following subsections.

Long Term Reliability and Effectiveness

Alternative 3: Pump-and-Treat, MNA, On-Site SSDS and Institutional Controls

The long-term effectiveness at achieving final corrective measure goals for groundwater is unknown, but it is unlikely pump-and-treat by itself would reduce contaminant concentrations to the final goals in a reasonable time. The Institutional Controls would be effective for preventing human exposures at both the PRR property and off-site locations. If the MNA monitoring program indicates MNA is occurring at the site, then it would be an effective corrective measures alternative in the long term. However, MNA of chlorinated solvents proceeds very slowly under aerobic conditions; therefore, in the absence of enhanced reductive dechlorination MNA would likely not be sufficient. The SSDS is able to effectively reduce contaminant concentrations in indoor air for the long term. The systems have been shown to operate reliably at the facility in the past. However, off-site soil gas has elevated concentrations of TCE and the long-term reliability of monitoring for potential residential vapor intrusion may not be adequate.

Alternative 4: Enhanced Reductive Dechlorination (ERD), Bioaugmentation, Pump-and-Treat, MNA, On-Site and Off-Site SSDS, Institutional Controls, Five-Year Remedy Reviews, and Financial Assurance

This alternative would have long-term effectiveness. The ERD pilot study has produced significant reduction in chemical mass; therefore, enhancing the long-term effectiveness for this alternative. The Institutional Controls would be effective for preventing human exposures to groundwater at the PRR property and off-site until final corrective measures goals are met. The SSDSs are able to effectively reduce contaminant concentrations in indoor air and protect residential indoor air in the future. The systems have been shown to operate reliably at the facility in the past. Treatment reducing the baseline levels of residual contamination provides a higher likelihood that natural attenuation could ultimately restore the groundwater and achieve MCLs. The Corrective Action Monitoring Plan will provide a framework by which to determine the rate and effectiveness of MNA.

Reduction of Toxicity, Mobility, and Volume of Waste

Alternative 3: This alternative would be moderately effective at reducing contaminant mobility and volume through containment and treatment. Contaminant toxicity reduction would be limited and timely through MNA alone. The pump-and-treat system currently operating has proven to be effective at controlling contaminant mobility and reducing the overall mass at the site. However, the groundwater pump-and-treat system would not reduce the residual TCE concentrations at secondary source areas within a reasonable timeframe.

Alternative 4: This alternative would be the most effective alternative at reducing the overall toxicity, mobility and volume through treatment. The pump-and-treat system and SSDS currently operating have proven to be effective at controlling contaminant mobility and reducing the overall mass at the site. The ERD pilot study has shown a significant reduction in contaminant mass at the pilot test area. Applying ERD site-wide should reduce the overall contaminant mass sooner than pump-and-treat alone. The ERD also has the capacity to reduce toxicity as it dechlorinates the VOCs, leaving behind non-toxic carbon dioxide and ethene. The mobility of contaminants would be controlled with the current pump-and-treat system.

Short-Term Effectiveness

Alternative 3 would be effective in the short term, as the existing pump-and-treat system would remain in operation and has been effective in controlling migration. The Institutional Controls would be effective in the short term for preventing human exposures at the PRR property and off-site. If the MNA monitoring program indicates MNA is occurring at the site, it would be an effective corrective measures alternative, but likely over the long term. The SSDSs are able to effectively reduce concentrations in indoor air. Because this alternative essentially just continues the current measures in place at the facility, it can be implemented immediately.

Alternative 4 would likely be effective in a shorter time than Alternative 3. A groundwater pump-and-treat system would remain effective for the short-term performance of the proposed alternative. The pilot study using ERD has shown reduction in chemical mass; therefore, short term effectiveness of the alternative is expected. The Institutional Controls would be effective in the short term for preventing human exposures at the PRR property and off-site. The SSDSs are able to effectively reduce concentrations in indoor air. This alternative has a greater ability to reduce mass and toxicity in a shorter time period than Alternative 3 by directly addressing the remaining source areas.

Implementability

Alternative 3 would not require any additional materials or equipment other than what is already routinely needed at the site to operate existing remedial measures. The groundwater pump-and-treat system has been implemented. A more extensive groundwater monitoring plan may be required for this alternative's MNA component. The pump-and-treat system and SSDS would not require any additional services and/or materials other than routine maintenance. This alternative is technically and administratively feasible.

Alternative 4 includes ERD in addition to continuing to operate the existing pump-and-treat system and monitoring program. The off-site SSDSs can be installed easily, provided access is granted by the homeowner. The ERD injectate is readily available and was used during the pilot study. Applying the injectate would occur via temporary injection wells that can be easily installed. The existing pump-and-treat system and SSDS would not require any additional services and/or materials other than routine maintenance. Monitoring and analytical services are available. This alternative is technically and administratively feasible to be implemented.

State and Community Acceptance

These proposed alternatives have been discussed, along with the conceptual site model, with the State. MDEQ's response was positive for the proposed alternative and EPA has attempted to address the State's concerns in this document.

Community acceptance of this proposed remedy will be assessed during the public participation period.

Cost

Cost will be evaluated for each alternative based on capital investment, annual O&M cost, and overall net present value. For O&M activities that may continue over several decades, a 30-year maximum is assumed. The actual costs may be as much as 50% higher to 30% lower than the estimated costs; therefore, a 20% contingency factor for each alternative's total capital cost is applied as an indirect cost to account for differences in approach that may be used during construction.

The capital costs for Alternative 3 are approximately $12,960. The O&M costs for years one through three are approximately $170,200 per year, for years four through seven approximately $111,400 per year, and for years eight through 30 are estimated to be $34,000 per year. The net present value for Alternative 3 is estimated to be $2,170,000.

Alternative 4 has higher capital cost than Alternative 3 because of the ERD, but lower net present value because of a shorter O&M time period. This alternative would shift the bulk of the remedial costs to a shorter timeframe (one to five years) versus a longer timeframe (up to 30 years).

The capital costs for Alternative 4 are approximately $442,000. The O&M costs include annual costs associated with operating the pump-and-treat system for three years, and annual costs associated with MNA monitoring. The estimated O&M costs for years one through three are $210,000 per year, and for years four through five the estimated annual costs are $48,000. The estimated annual cost for years six through 14 is $32,000. The estimated annual cost for years 15-30 is $7,000. Based on the total capital and O&M costs listed above, the net present value for Alternative 4 is estimated to be $1,690,000. Alternative 4 is expected to cost less than Alternative 3 and complete remediation at the site in a shorter time frame, while providing more protection to off-site residents in the short-term.

PUBLIC PARTICIPATION

EPA solicits input from the community on the cleanup methods proposed under each of the previous alternatives, and on EPA's preferred alternative as described in this document. EPA has set a public comment period from May 7 – June 22, 2015, to encourage public participation in the selection process. We encourage community members to submit any comments regarding these proposed remedies in writing by June 22, 2015. If requested during the public comment period, EPA will also host a public meeting in Dowagiac to hear public comments. To request a public meeting, contact EPA Project Manager Michelle Kaysen (see contact information below).

The EPA administrative record is available at the following locations (please call for hours):

EPA, Region 5
7th Floor Record Center
77 W. Jackson Blvd.
Chicago, IL 60604
(312) 886-4253

Dowagiac District Library
211 Commercial St.
Dowagiac, MI
(269) 782-3826

EPA will summarize public comments and provide responses in the Response to Comments. EPA will draft the Response to Comments at the conclusion of the public comment period and incorporate the Response to Comments into the EPA administrative record. To send written comments or obtain further information, contact:

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